

CLAIMS

What is claimed is:

1. A method for preparing a catalyst support comprising:
 - (a) combining one or more refractory-oxide precursors with one or more structural promoter precursors to yield a precursor mixture;
 - (b) forming a support precursor from the precursor mixture; and
 - (c) calcining the support precursor to obtain a hydrothermally-stable structurally-promoted refractory-oxide catalyst support, wherein the catalyst support comprises the hydrothermally-stable structurally-promoted refractory-oxide catalyst support.
2. The method of claim 1 wherein step (b) comprises hydrolysis of the one or more refractory-oxide precursors.
3. The method of claim 1 wherein step (b) comprises co-hydrolysis of the one or more refractory-oxide precursors and the one or more structural promoter precursors.
4. The method of claim 1 wherein step (b) comprises precipitation of the one or more refractory-oxide precursors.
5. The method of claim 1 wherein step (b) comprises co-precipitation of the one or more refractory-oxide precursors and the one or more structural promoter precursors.

6. The method of claim 1 wherein the precursor mixture comprises a sol and step (b) comprises gelling the sol.
7. The method of claim 1 wherein the support precursor comprises alumina and the one or more refractory-oxide precursors comprise alumina precursors.
8. The method of claim 7 wherein the one or more refractory-oxide precursors are inorganic precursors, wherein the inorganic precursors comprise at least one precursor selected from the group consisting of aluminum nitrate, aluminum sulfate, sodium aluminate, and aluminum chloride.
9. The method of claim 7 wherein the one or more refractory-oxide precursors comprise at least one aluminum alkoxide.
10. The method of claim 7 wherein the hydrothermally-stable structurally-promoted refractory-oxide catalyst support is a modified alumina support.
11. The method of claim 7 wherein the precursor mixture comprises a sol, and wherein step (b) comprises gelling the sol.
12. The method of claim 1 wherein gelling the sol occurs at a temperature between about 70 °C and about 100 °C.

13. The method of claim 1 wherein the one or more structural promoter precursors comprise at least one element selected from the group consisting of W, Ta, Nb, Th, Ge, U, Sn, Sb, V, Hf, Na, K, B, Mg, Si, Ca, Ti, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ga, Sr, Zr, Ba, and the lanthanides.
14. The method of claim 1 wherein step (b) further comprises steaming the support precursor.
15. A catalyst comprising a catalytic metal dispersed on the catalyst support prepared by the method of claim 1.
16. The catalyst according to claim 15 wherein the catalytic metal comprises Co, Ni, Fe, Ru, or combinations thereof.
17. A hydrothermal reaction process comprising contacting a feed stream with the catalyst of claim 16.
18. The process according to claim 17 wherein the feed stream comprises synthesis gas and the catalytic metal comprises cobalt.
19. The process of claim 18 further comprising converting at least a portion of the synthesis gas to hydrocarbons.

20. A method for preparing a hydrothermally-stable structurally-promoted refractory-oxide catalyst support comprising:

(a) forming a refractory-oxide material as a slurry or sol from one or more refractory-oxide precursors;

(b) adding one or more structural promoter precursors to the refractory-oxide material; and

(c) calcining the refractory-oxide material to obtain the hydrothermally-stable structurally-promoted refractory-oxide catalyst support.

21. The method of claim 20 wherein step (a) comprises hydrolysis of the one or more refractory-oxide precursors.

22. The method of claim 20 wherein step (a) and step (b) comprise co-hydrolysis of the one or more refractory-oxide precursors and the one or more structural promoter precursors.

23. The method of claim 20 wherein step (a) comprises precipitation of the one or more refractory-oxide precursors.

24. The method of claim 20 wherein step (a) and step (b) comprise co-precipitation of the one or more refractory-oxide precursors and the one or more structural promoter precursors.

25. The method of claim 20 wherein step (a) further comprises gelling the refractory-oxide material by a sol-gel process.

26. The method of claim 25 wherein the sol-gel process is conducted at a temperature between about 70 °C and about 100 °C.

27. The method of claim 20 wherein step (b) further comprises gelling the refractory-oxide material by a sol-gel process after adding one or more structural promoter precursors to the refractory-oxide material.

28. The method of claim 27, wherein the sol-gel process is conducted at a temperature between about 70 °C and about 100 °C.

29. The method of claim 20 wherein the refractory-oxide material comprises alumina and the one or more refractory-oxide precursors comprise an alumina precursor.

30. The method of claim 29 wherein the one or more refractory-oxide precursors comprise at least one precursor selected from the group consisting of aluminum nitrate, aluminum sulfate, sodium aluminate, and aluminum chloride, and wherein the formation of the refractory-oxide material occurs by precipitation of the one or more refractory-oxide precursors.

31. The method of claim 29 wherein the one or more refractory-oxide precursors comprise aluminum alkoxides.

32. The method of claim 29 wherein the hydrothermally-stable structurally-promoted refractory-oxide catalyst support is a modified transition alumina support.

33. The method of claim 29 wherein the one or more structural promoter precursors comprise at least one element selected from the group consisting of W, Ta, Nb, Th, Ge, U, Sn, Sb, V, Hf, Na, K, B, Mg, Si, Ca, Ti, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ga, Sr, Zr, Ba, and the lanthanides.

34. The method of claim 29 wherein step (c) further comprises treating the refractory-oxide material to a steam treatment prior to calcination.

35. The method of claim 29 wherein the calcination takes place at a temperature between about 400 °C and about 900°C.

36. The method of claim 29 further comprising gelling the refractory-oxide material by a sol-gel process before or after the addition of the one or more structural promoter precursors.

37. The method of claim 36 wherein the sol-gel process is conducted at a temperature between about 70 °C and about 100 °C.

38. The method of claim 36 wherein the one or more refractory-oxide precursors comprise at least one precursor selected from the group consisting of aluminum nitrate, aluminum sulfate, sodium aluminate and aluminum chloride.

39. The method of claim 36 wherein the one or more refractory-oxide precursors comprise aluminum alkoxides.
40. The method of claim 36 wherein the hydrothermally-stable structurally-promoted refractory-oxide catalyst support is a modified transition alumina support.
41. The method of claim 36 wherein the one or more structural promoter precursors comprise at least one element selected from the group consisting of W, Ta, Nb, Th, Ge, U, Sn, Sb, V, Hf, Na, K, B, Mg, Si, Ca, Ti, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ga, Sr, Zr, Ba, and the lanthanides.
42. The method of claim 36 wherein formation of the refractory-oxide material occurs by co-precipitation of the one or more refractory-oxide precursors and the one or more structural promoter precursors.
43. The method of claim 36 wherein the calcination takes place at a temperature of between about 400 °C and about 900 °C.
44. A Fischer-Tropsch catalyst comprising
a hydrothermally-stable structurally-promoted refractory-oxide catalyst support; and
a catalytic metal effective in catalyzing a Fischer-Tropsch reaction.
45. The Fischer-Tropsch catalyst of claim 44 wherein the hydrothermally-stable structurally-promoted refractory-oxide catalyst support comprises alumina.

46. The Fischer-Tropsch catalyst of claim 44 wherein the catalytic metal comprises cobalt, nickel, ruthenium, iron, or combinations thereof.

47. The Fischer-Tropsch catalyst of claim 44 further comprising one or more catalytic promoters selected from the group consisting of Re, Na, K, Rb, Cs, Mg, Ca, Sr, Ba, Cu, Ag, Au, Sc, Y, La, Ti, Zr, Hf, V, Nb, Ta, Pd, Rh, Os, Ir, Pt, Mn, B, Ru, P, and combinations thereof.

48. The Fischer-Tropsch catalyst of claim 47 wherein the one or more catalytic promoters are selected from the group consisting of platinum, ruthenium, copper, silver, boron, and phosphorous.